ABSTRACT

Tantalum oxide (TaOx) nanoparticles were successfully synthesized using the pulsed laser ablation method with a Nd:YAG laser source at a wavelength of 1064 nm in sodium alginate solution medium at concentration variations of 0.3%, 0.5%, and 0.7%. Nanoparticle characterization was performed using UV-Vis, FTIR, FESEM-EDX, and XRD to determine optical properties, functional groups, morphology, and crystal structure. Contrast agent performance was evaluated using helical CT-Scan at a tube voltage of 120 kV and tube current of 140 mA, analyzed through CT-Number (HU) and Contrast-to-Noise Ratio (CNR) parameters. Characterization results showed that UV-Vis revealed a characteristic TaOx absorption peak at 295–296 nm, FTIR confirmed successful alginate coating through C-H, COO^-, and C-O-C functional groups, FESEM showed spherical morphology with an average particle size of 45–50 nm, and XRD identified an amorphous TaOx pattern indicated by a broad hump background in the $2\theta = 20–30°$ range in both samples, consistent with pulsed laser ablation synthesis without heat treatment, accompanied by semi-crystalline alginate characteristic peaks at $2\theta = 13.83°$ and $15.26°$ detected in the TaOx+Alginate sample. Contrast agent evaluation demonstrated that tantalum nanoparticles consistently produced higher HU values than conventional iodine-based contrast agents, attributed to both the higher atomic number of tantalum and the substantially higher mass concentration of TaOx tested compared to iodine, with the highest HU and CNR obtained at 0.3% concentration (HU = 8.13; CNR = 3.66). Therefore, TaOx nanoparticles in alginate medium demonstrate promising preliminary potential as a candidate next-generation CT-Scan contrast agent.

Keywords: *pulsed laser ablation, alginate, CT-Scan contrast agent, tantalum oxide nanoparticles*